

Case No: 9702(2)

Claims

1. A method of introducing an oil field or gas field production chemical into a hydrocarbon-bearing porous subterranean formation penetrated by a wellbore comprising:
injecting a gelling composition comprising an aqueous liquid, an oil field or gas field
5 production chemical, and a gellable polymer through the wellbore into the porous subterranean formation wherein the gellable polymer forms a gel within the pores of the subterranean formation thereby encapsulating the production chemical in the gel; and controllably releasing the production chemical from the gel into a formation fluid.
2. A method of increasing the effectiveness of an oil or gas field production
10 chemical by reducing the number of squeezing and shut-in operations needed to increase the production rate from a wellbore penetrating a hydrocarbon-bearing porous subterranean formation, said method comprising:
A) injecting a gelling composition comprising an aqueous liquid, an oil or gas field
production chemical and a gellable polymer through the wellbore into the porous
15 subterranean formation wherein the polymer forms a gel in the formation thereby encapsulating the oil or gas field production chemical in the gel;
B) after injecting the gelling composition, optionally over-flushing the porous subterranean formation with an aqueous fluid or an oil;
C) subsequently, shutting-in the well for a period of time; and
20 D) putting the well back on production and controllably releasing the oil or gas field production chemical from the gel into a formation fluid that is being produced from the well.
3. A method as claimed in Claims 1 or 2 wherein the gelling composition

comprises (i) an aqueous liquid, (ii) an oil or gas field production chemical, (iii) a gellable polymer having crosslinkable groups, and (iv) a crosslinking agent and wherein the gel is formed within the pores of formation through crosslinking of the crosslinkable groups of the gellable polymer with the crosslinking agent.

5 4. A method as claimed in any one of the preceding claims wherein the production chemical is controllably released from the gel into the formation fluid in the near wellbore region of the formation.

5. A method as claimed in any one of the preceding claims wherein the formation fluid is selected from the group consisting of a formation brine, crude oil, natural gas and
10 gas field condensate.

6. A method as claimed in any one of Claims 3 to 5 wherein the gellable polymer is dispersed or dissolved in a first aqueous fluid (hereinafter "polymer slug"), the crosslinking agent is dissolved in a second aqueous fluid (hereinafter "crosslinking agent slug"), the production chemical is dispersed, suspended or dissolved in the polymer slug
15 and/or the crosslinking agent slug and the gelling composition is formed within the pores of the formation by either: (a) injecting the polymer slug into the porous subterranean formation prior to injecting the crosslinking agent slug and back-producing the polymer slug over the crosslinking agent slug or (b) injecting the crosslinking agent slug into the porous subterranean formation prior to injecting the polymer slug and back-producing
20 the crosslinking agent slug over the polymer slug.

7. A method as claimed in Claim 6 wherein an aqueous spacer is injected between the polymer slug and crosslinking agent slug and optionally an aqueous pre-flush fluid is injected into the porous subterranean formation prior to injection of the polymer slug, crosslinking slug and aqueous spacer.

25 8. A method as claimed in Claim 7 wherein the production chemical is dissolved, dispersed or suspended in one or more of the aqueous pre-flush fluid, the polymer slug, the crosslinking agent slug or aqueous spacer.

9. A method as claimed in any one of the preceding claims wherein the oil or gas field production chemical is selected from the group consisting of (i) scale inhibitors,
30 (ii) corrosion inhibitors, (iii) hydrogen sulphide scavengers and (iv) hydrate inhibitors.

10. A method as claimed in any one of the preceding claims the production chemical is suspended in the aqueous liquid in the form of particles having a particle size of 100% less than 10 microns.

11. A method as claimed in Claim 10 wherein the particles of production chemical are coated with a coating agent selected from water-soluble polymers and oil-soluble polymers.
12. A method as claimed in any one of the preceding claims wherein the gellable polymer is selected from the group consisting of biopolysaccharides, cellulose ethers and acrylamide-containing polymers.
13. A method as claimed in any one of the preceding claims wherein the concentration of the gellable polymer in the gelling composition is in the range of about 0.01 to 0.5 weight percent.
14. A method as claimed in any one of the preceding claims wherein the gelling composition additionally comprises a buffering agent having a buffering capacity at a pH of up to about 5.5.
15. A method as claimed in Claim 14 wherein the buffering agent is present in the gelling composition at a concentration in the range 0.001 to 10% by weight based on the weight of the gelling composition.
16. A method as claimed in any one of claims 3 to 15 wherein the cross-linking agent is a polyvalent metal compound selected from the group consisting of polyvalent compounds of zirconium, titanium, aluminum, iron, chromium, hafnium, niobium and antimony.
17. A method as claimed in Claim 16 wherein the concentration of crosslinking agent in the gelling composition is from 0.001 to 0.5 weight percent based on the concentration of the polyvalent metal.
18. A method as claimed in any one of Claims 2 to 17 wherein the well is shut-in for a period of up to 50 hours before putting the well back on production.
19. A method as claimed in any one of the preceding claims wherein the amount of production chemical in the gelling composition is in the range from 1-25% by weight.
20. A method as claimed in any one of the preceding claims wherein the production chemical is released into the formation fluid through thermal and/or biodegradation of the gel under the conditions encountered in the formation.
21. A method as claimed in Claim 20 wherein the gel starts to thermally degrade at a temperature in the range 50 to 150°C.
22. A method as claimed in any one of Claims 1 to 19 wherein the gelling

composition contains an effective amount of a gel breaker so as to provide controlled breaking of the gel.

23. A method as claimed in Claim 22 wherein the gelling composition comprises from 0.1 to about 10 wt% of gel breaker.

5 24. A delayed release gelling composition comprising (i) an aqueous liquid, (ii) an oil field or gas field production chemical, and (iii) a gellable polymer wherein the composition has a gelation rate of longer than 1 hour.

25. A delayed release gelling composition as claimed in Claim 24 wherein the gellable polymer has crosslinkable groups, and the composition additionally
10 comprises (iv) a crosslinking agent.

26. A delayed release gelling composition as claimed in Claims 24 or 25 wherein the oil or gas field production chemical is selected from the group consisting of (i) scale inhibitors, (ii) corrosion inhibitors, (iii) hydrogen sulphide scavengers and (iv) hydrate inhibitors.

15 27. A delayed release gelling composition as claimed in any one of Claims 24 to 26 wherein the production chemical is suspended in the aqueous liquid in the form of particles having a particle size of 100% less than 10 microns.

28. A delayed release gelling composition as claimed in Claims 27 wherein the particles of production chemical are coated with a coating agent selected from water-
20 soluble polymers and oil-soluble polymers.

29. A delayed release gelling composition as claimed in any one of Claims 24 to 28 wherein the gellable polymer is selected from the group consisting of biopolysaccharides, cellulose ethers and acrylamide-containing polymers.

30. A delayed release gelling composition as claimed in any one of Claims 24 to 29
25 wherein the concentration of the gellable polymer in the gelling composition is in the range of about 0.01 to 0.5 weight percent.

31. A delayed release gelling composition as claimed in any one Claims 24 to 30 wherein the gelling composition additionally comprises a buffering agent having a buffering capacity at a pH of up to about 5.5.

30 32. A delayed release gelling composition as claimed in Claim 31 wherein the buffering agent is present in the gelling composition at a concentration in the range 0.001 to 10% by weight based on the weight of the gelling composition.

33. A delayed release gelling composition as claimed in any one of Claims 25 to 32

wherein the cross-linking agent is a polyvalent metal compound selected from the group consisting of polyvalent compounds of zirconium, titanium, aluminum, iron, chromium, hafnium, niobium and antimony.

34. A delayed release gelling composition as claimed in Claim 33 wherein the
5 concentration of crosslinking agent in the gelling composition is from 0.001 to 0.5 weight percent based on the concentration of the polyvalent metal.
35. A delayed release gelling composition as claimed in any one of Claims 24 to 34 wherein the amount of production chemical in the gelling composition is in the range from 1-25% by weight.
- 10 36. A delayed release gelling composition as claimed in any one of Claims 24 to 35 wherein the gelling composition contains an effective amount of a gel breaker so as to provide controlled breaking of the gel.
37. A delayed release gelling composition as claimed in Claim 36 wherein the gelling composition comprises from 0.1 to about 10 wt% of gel breaker.
- 15 38. Use of a delayed release gelling composition as defined in any one of Claims 24 to 37 to treat a hydrocarbon-bearing porous subterranean formation by injecting the gelling composition into the porous subterranean formation and forming a gel within the pores of the formation thereby encapsulating the production chemical in the gel.